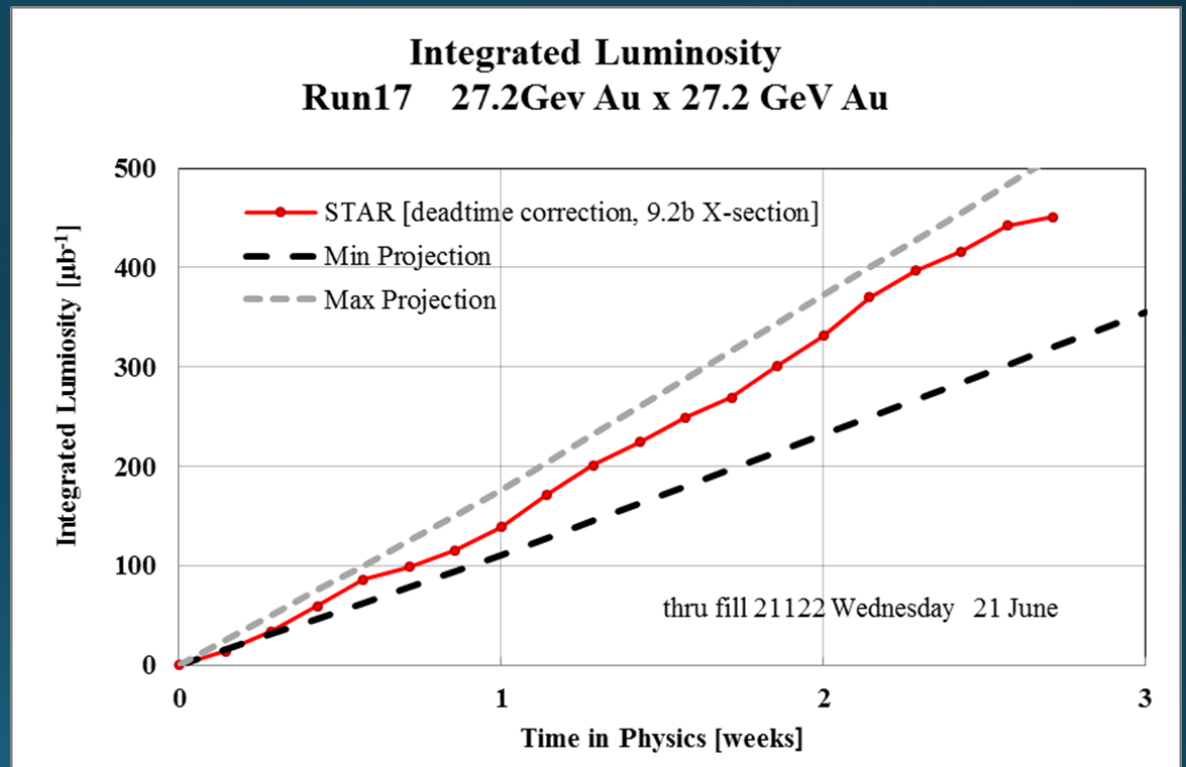


Run Coordinator: Gregory Marr

Run-17 Au+Au Review  
Run-18 Zr+Zr, Ru+Ru Plans

# Run-17 Overview: Au+Au Performance

- At CeC energy: 27.2 GeV
- No stochastic cooling
- We were able to meet our projected luminosity performance goals.



# Run-17 Overview: Au+Au Challenges

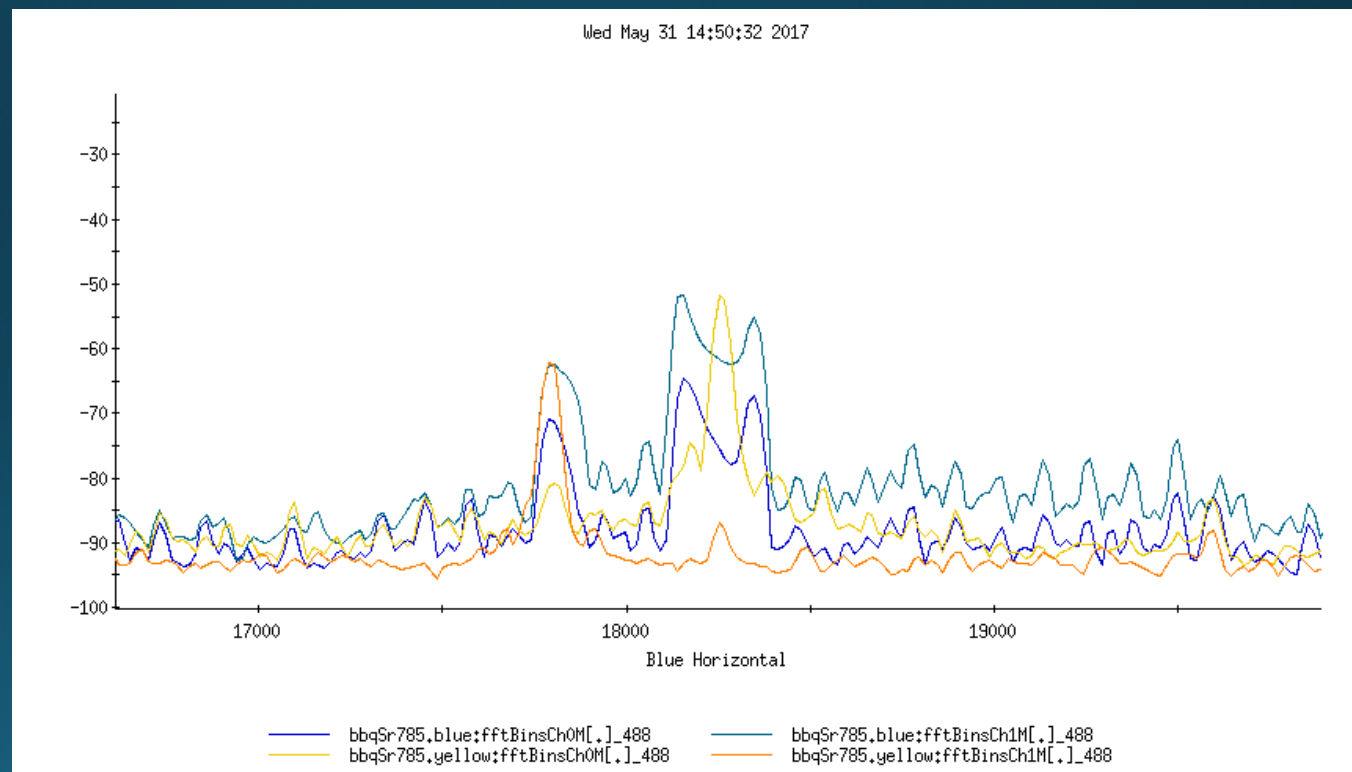
- Start-up: consecutive failures
  - 5/30-6/3/17: Equal time failure, machine setup:
    - BMMPs
    - A5 kicker delay module (multiple times)
    - Booster RF driver amplifier (multiple times)
    - AGS RF station tuning
    - RHIC smoke detector
    - BTA vacuum interlocks
    - Cryo lead flow
    - RHIC RF storage cavities
    - Yellow dipole feedback memory issue
    - EBIS trips
    - RHIC Landau cavity trips
- Landau cavity stability
  - Good news: largely solved
- Unsolved issues
  - Yellow debunching at injection
  - Yellow Booster noise at injection & store
  - Blue ramp tune feedback issues
- Multiple species changes in Collider
  - Somewhat more automated this run
  - Seemed fraught with random failures
- Limited transmission efficiency.
  - Not on par with Run 16, considering beam intensity.

# Blue ramp: tune issues

Anomalous peaks in BBQ tune caused lock issues and ramps failed when tune feedback ran away.

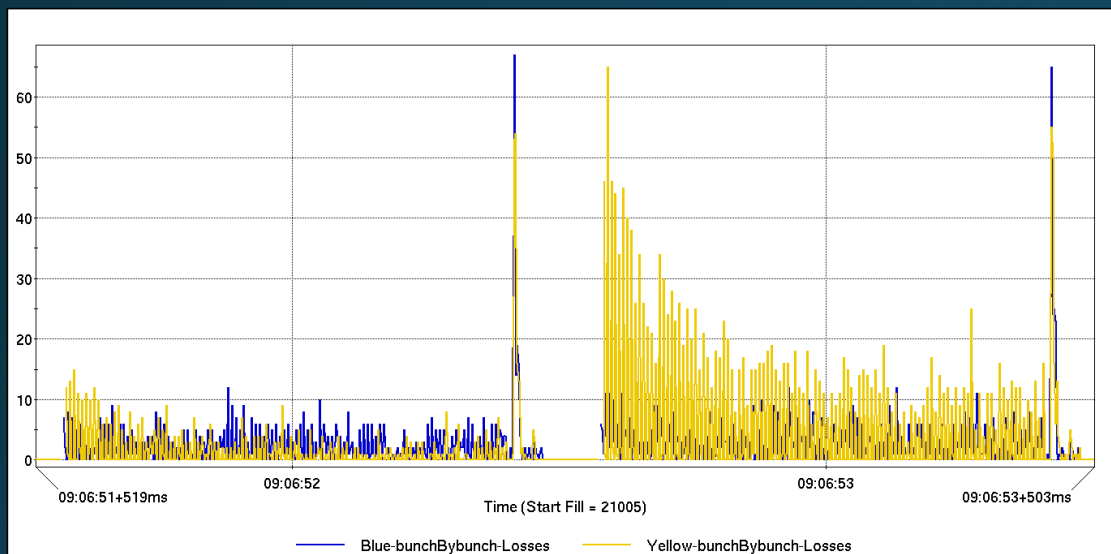
Target tunes were same as previous runs, but had to be changed (+0.004) to avoid this.

Cause was never identified.

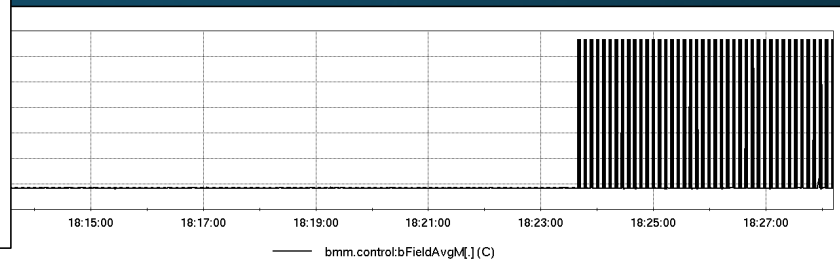




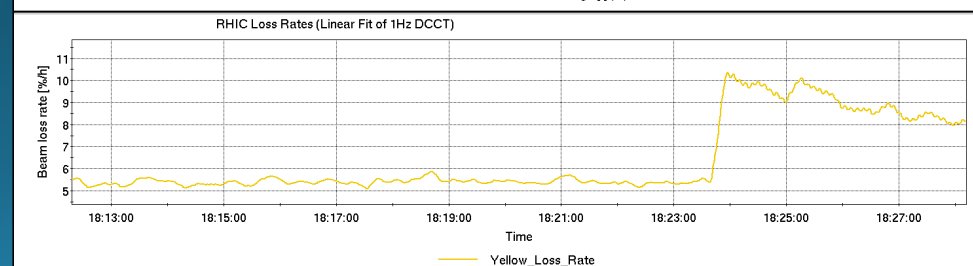
# Yellow noise, losses



Yellow loss rates increase when Booster Main Magnet is pulsing. Blue beam did not see similar effect.



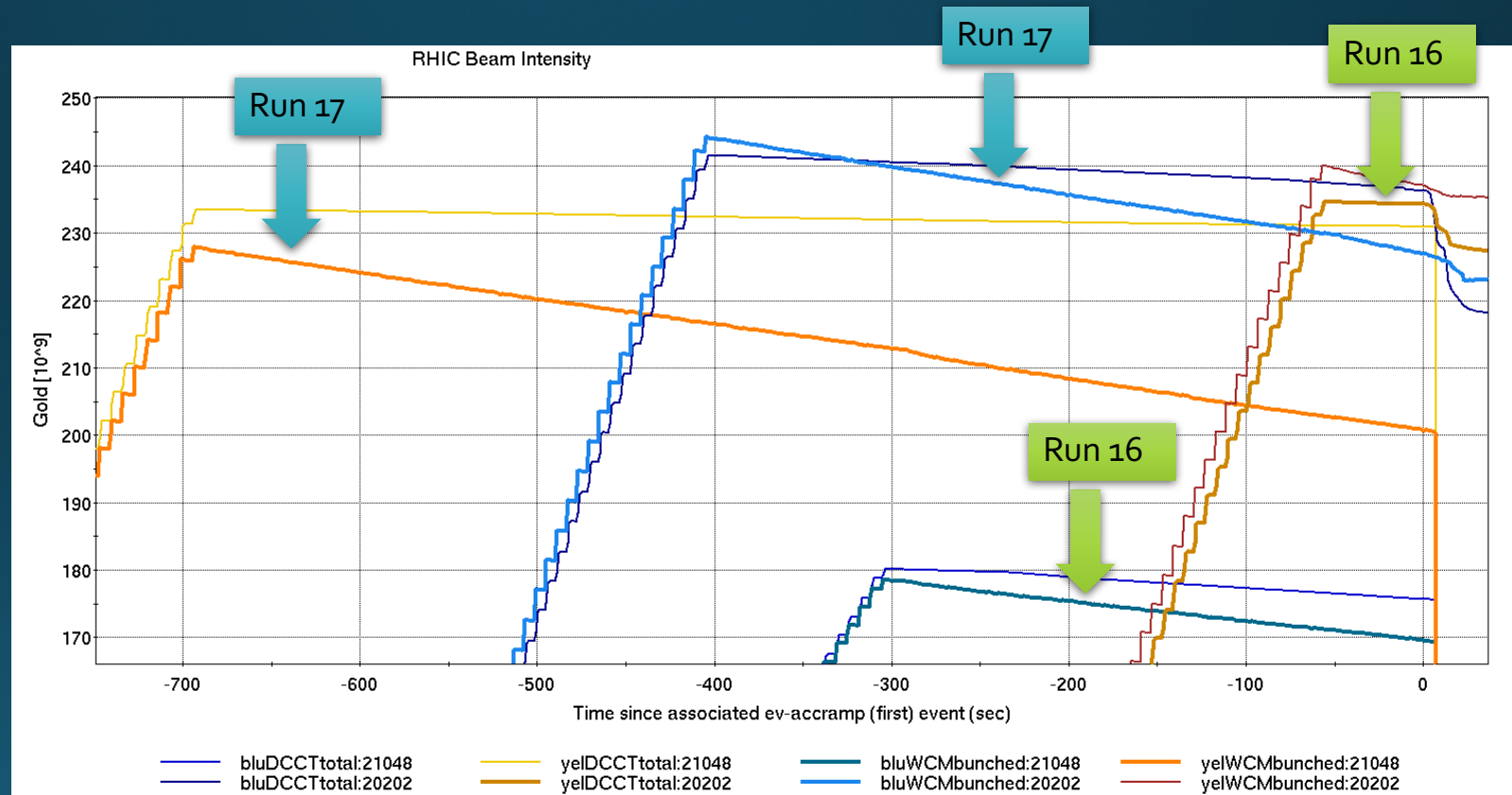
We were unable to find a cause or tune around the effect.



# Yellow injection: debunching

At injection, Yellow beam was debunching more quickly than Blue.

Rate was worse this run compared to Run-16 Au.



# Run-17 Coordination Notes: CeC

- It's not an experiment. It's not an operational system either.
  - We struggle to manage this third category at the outset (e.g. elens, 56MHz, etc.). It gets better with time. Time remains a limited resource, however.
  - Lives at the perimeter of Run Coordinator and Scheduling Physicist's purview.
- They often couldn't specify what their needs were or when they wanted them. Not unusual for a developing project, but it was difficult to anticipate and schedule.
- Did CeC make the most efficient use of their time?
  - I don't think we (Operations) helped them improve. Could we have been of greater service?
  - I'm not sure CeC staff knew the extent of our tools/expertise, or knew to ask questions (ask the right questions).
  - With STAR ahead of some goals, would dedicated beam time have been appropriate?

# Run-18 Planning: Zr+Zr, Ru+Ru

- Ramp/Lattice

- Beam energy 100 GeV/N, ( $\sqrt{s_{NN}} = 200$  GeV)
- Stochastic cooling
- Do we need  $\beta^* < 1\text{m}$ ?
  - Likely determined by Ru achievable luminosity...
  - No less than 0.7m

- Equal lattice/beam conditions desired for Zr, Ru

# More (even more?) mode switches

- Warning: species switches = less integrated luminosity.
  - CeC will require periods of Au-Au
  - As presently scheduled, we must switch the Collider species more than any species or energy change in any past run.
    - (Au?)->Zr->Au->Zr->Ru->Au->Ru->Au->low energy Au
- Mode switching in the injectors is commonplace. Is it time to make it so in RHIC?
  - Additional setup effort – and time – required.
- Tandem will need to change schedule to provide Ru at beginning of run.
- Zr not compatible with NSRL running (EBIS LION issues)?

# Run-18 Challenges: Intensity

- Source limited. Will tuning time be limited due to availability of enriched source material?
  - See following talk (Raparia).
  - Should we set up with Au in beginning?
- Previously achieved (courtesy Gardner, Kling)
  - Zr:  $\sim 5 \times 10^6$   $^{96}\text{Zr}^{16+}$  transported through Booster (with  $^{90}\text{Zr}^{15+}$ ) to NSRL line target with naturally abundant ( $\sim 2\text{-}3\%$ ) Zr source
  - Ru:  $\sim 1 \times 10^9$   $^{96}\text{Ru}^{44+}$  ions/bunch at AGS extraction (from Tandem) with naturally abundant ( $\sim 5.5\%$ ) Ru source and 8-4-2 merge in injectors
- Projected
  - Zr: Enriched source should provide more ions than Ruthenium, approaching Gold-like intensities ( $2 \times 10^9$  or better).
    - 12 EBIS/Booster cycles, 6-3-1 merge in AGS
  - Ru: Estimate  $\sim 1.5 \times 10^9$  ions/bunch available
    - 8 Tandem/Booster pulses, 8-4-2 merge in AGS

# Run-18 Planning: Challenges

- Zr yet to be transported to/accelerated in AGS
  - Biggest hurdle will be selecting proper isotope & charge state in BTA downstream of stripping foil.
- Machine/experiment protection
  - This storage Bp could be susceptible to prefires.
  - See previous talk (Drees).
- Concurrent project commissioning
  - LEReC and CeC: only one at a time? (cryo).
  - You can't start beam while you finish installations...
  - If access is already predicted to be more frequent, it behooves us to make it more streamlined than the present awkward circus. *Fugit irreparabile tempus.*



# Run-18 Planning: Au-Au

- Medium Energy for STAR
  - Beam Energy 13.5 GeV ( $\sqrt{s_{NN}} = 27$  GeV)
  - Below transition
  - $\beta^* = 3\text{m}$ ?
  - Previously set up in Run-11, 8 day run
    - Used “IBS suppression lattice” Au11v6
  - ~1 hour stores
  - No stochastic cooling
- Au for CeC
  - Uses previously established Au17 ramp
  - Low intensity, bunch number



# Run-18 Planning: Low energy Au

- Fixed target at STAR
- Beam energy 3.85 GeV
- Can this be done with CeC beampipe? It won't be as easy as last time.
- Run-10: It wasn't easy last time.
  - 49 hours setup
  - Sextupole polarity reversal
  - 6m  $\beta^*$  at IP6
  - $h=369$
  - 10 min stores
  - Broke the vacuum at the yellow injection kicker
  - Intensity  $0.5 \times 10^9$ /bunch, loss-limited in ATR.

# Summary

- The Run-17 heavy ion program was a successful, albeit short, run.
- The short program did not afford us much time to investigate or address a number of issues that appeared during the run. We should be prepared for their possible recurrence in Run-18.
- Run-18 will be challenged with numerous species changes. Efficient use of setup time will be important.
- My thanks to Operations, CAS and all support groups and specialists for their effort in Run-17, and for their upcoming work towards a successful Run-18.